Energy and Food Chains

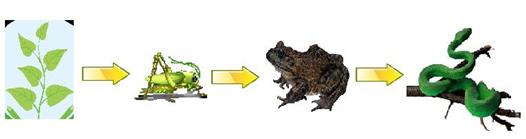
When you eat, you are putting energy, or calories, into your body. Where does the energy originate?

Energy enters most ecosystems in the form of sunlight. Organisms, called **producers**, convert the sunlight into chemical energy using a process called photosynthesis. All organisms who cannot make their own energy are called **consumers** and they are directly or indirectly dependant on the output of the producers.

A food chain is the pathway along which food is transferred from one organism to another. Organisms are divided into trophic levels to help us determine where they fit into an ecosystem. Producers will always be positioned in the first trophic level. Primary consumers, those that consume only producers, are located at the second trophic level. Secondary consumers are at the third trophic level, and so on.

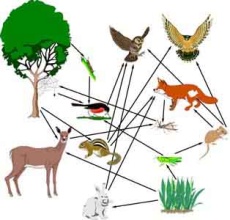
**Trophic Level**

**1 2 3 4**



A simple one-way flow food chain. Note that the arrows are in the direction in which the food is going,   
e.g., the frog eats the grasshopper. In this example the frog is a secondary consumer. The snake eats the frog and is therefore called a tertiary consumer

Decomposers (e.g., worms, maggots, bacteria) are a special type of consumer that break down organic wastes and the remains of dead organisms at all of the trophic levels. Decomposers often form a major link between the primary producers and the consumers.

**In the food chain above the snake eats the frog. Do snakes eat other organisms?**Yes, in most cases animals will have a buffet of choices and therefore may fit into a variety of different food chains. If the food chains are woven together they form a food web.

**Limiting Ecosystems: Energy**

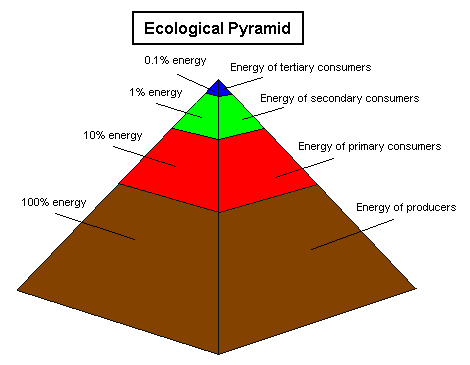
The amount of energy in an ecosystem (**biomass**) is dependent on:

* How much sunlight it receives.
* Seasonal changes in the environment (precipitation, temperature, etc.).
* The availability of inorganic nutrients.

These conditions control what type of ecosystem can form (tropical rainforest vs. desert). These types of ecosystems are called biomes.

The amount of energy that is transferred along a food chain decreases considerably from trophic level to trophic level. Only about 10% of the energy available at each trophic level is converted to new biomass. The other 90% of available energy is used as energy for respiration and body functions, or it is lost as waste.

This decrease in available energy for new biomass limits the number of organisms at higher trophic levels resulting in fewer individuals of a species as you move along.



A pyramid of numbers is a graphical representation indicating the population at each level in a food chain. The pyramid shape is produced as there are generally fewer organisms at each successive trophic level. With this representation it is clear that the populations at higher trophic levels are limited by the numbers of species (potential food resources) at lower trophic levels.

**Bioaccumulation**

Another factor that will affect the populations of species particularly at higher trophic levels is the accumulation of toxins.

Poisons can be passed along a food chain. The concentration of toxins, especially those that are fat soluble, increase in higher order carnivores in a process called bioaccumulation. Top carnivores (e.g., ospreys, falcons) at the ends of longer food chains suffered declines in population size in the 1970's due to the accumulation of a fat soluble pesticide called DDT. DDT has since been banned here in Canada.

How toxins can accumulate:

1. A marsh is first sprayed with a pesticide to control mosquitoes.
2. Trace amounts of the pesticide accumulate in the aquatic microorganisms.
3. Insect larvae that feed on the microorganisms eat a large quantity and the toxins accumulate.
4. This process of accumulation continues through small fish, larger fish, and then to top carnivores such as hawks, gulls, and falcons.